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ABSTRACT

Reported is a study designed to determine the effects of diagnostic testing followed by prescribed remediation on the immediate and retained science achievement of middle school students, and to determine if effects of treatment were consistent across students' race and locus of control (LOC) levels. Three intact seventh-grade science classes were randomly assigned to the following treatment levels: (1) Comparison level - objectives only; (2) Experimental level I - diagnostic level; and (3) Experimental level II - diagnostic/remediation level. Data were analyzed using ANOVA procedures in a 3x2x2 (treatment x LOC x race) factorial design. Pretreatment achievement data were used as the covariates. The study indicates that students who experienced diagnostic remedial instruction showed a 10% - 12% greater retention of science concepts. Internal LOC students scored higher than did external students. White students showed greater retention than did black students, but these differences were reduced through the use of diagnostic remedial instruction. (Author/GA)

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THE EFFECTS OF DIAGNOSIS, REMEDIATION AND LOCUS OF CONTROL ON ACHIEVEMENT, RETENTION, AND ATTITUDES OF MIDDLE SCHOOL SCIENCE STUDENTS

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The Effects of Diagnosis, Remediation
and Locus of Control on Achievement, Retention,
and Attitudes of Middle School Science Students

Educators are continually faced with the problem of how to facilitate and increase classroom learning. Many techniques used to increase the students' acquisition, comprehension, and retention of subject matter have been suggested. One of these procedures arises from Bloom's philosophy of "mastery teaching". This philosophy arises from the belief that possibly as many as 95% of the students could achieve that which is expected of them if given the opportunity, enough time, and feedback (Block & Burns, 1977). "Mastery teaching" is characterized by specific objectives to guide the students' learning, diagnostic tests for feedback, and remediation on objectives not attained.

Recent research indicates that when diagnosis is used along with prescriptive teaching, student achievement and retention is increased (Kim, et al, 1974; Lee, et al, 1971; and Okey, 1977). Goodson and Okey (1978) found that diagnosis used with objectives increased students' retention and Yeany, Waugh, and Blalock (1978) reported that feedback from diagnostic quizzes positively influenced science achievement.

The above research assumes that the student will take some responsibility for correcting any learning deficiencies. A question that then arose deals with the student's perception of himself in regard to how much control he or she has in correcting these learning problems.

Rotter (1966) developed a Locus of Control inventory to measure the degree to which a person perceives his fate as internally or externally guided. Its major points are as follows: those people who tend to believe that outside

forces, such as luck and destiny, shape their lives are referred to as "external"; and, those people who believe that each person determines his course in life, where luck and destiny are just excuses, are referred to as "internal". It is possible then that those people who are internal would benefit more from diagnosis and remediation than those who are external because they use feedback and remediation activities to a higher degree than the external students.

When considering diagnostic - prescriptive teaching and locus of control, many questions arise. The following three questions provide the focus of this study: (1) Is the diagnostic - prescriptive teaching method effective for middle school science students? (2) Are the effects on achievement brought about by diagnostic-prescriptive teaching consistant for both black and white students? (3) Will the internally controlled student use the feedback in a way that will facilitate achievement better than a student with an external locus of control?

The purposes of this study were to assess the effects of diagnostic - prescriptive teaching, locus of control, and race on the immediate and retained achievement of middle school science students.

PROCEDURES

Subjects

The experimental population consisted of three intact seventh-grade science classes. Treatment levels were randomly assigned to these classes. The students ranged from eleven to thirteen years of age. Each class was heterogenous with respect to socioeconomic status, race and sex. Classes met with the instructor five days a week for 55 minutes each day. The instructor had previous experience using the diagnostic teaching method.

Treatment Levels

The treatment levels represent points on a diagnostic-prescriptive continuum. One end of this continuum is represented by instruction where no objectives, diagnosis or remediation are given. The opposite end is represented by instruction where objectives are given, diagnostic measures are administered for each objective, and remediation is supplied where needed. The three treatment levels in this study were Objectives Only (T_1), Diagnostic level (T_2), and the Diagnostic Remediation level (T_3).

The Objectives Only Level (T_1) was the control group. Subjects in this group received a set of 27 objectives, followed by three weeks of instruction, the first summative test (SA), two more weeks of instruction, then the second summative test (SB). Approximately one month later the retention measure was administered. During instruction students and teachers engaged in their normal classroom activities which included lecture, reading, filmstrips, and demonstrations. The first instructional phase focused on the first 15 objectives while the second phase was based on the last 12 objectives.

The Diagnostic Level (T_2) was the experimental group that was given the same 27 objectives and also periodic diagnostic measures after each set of five objectives were covered. The diagnostic measures were corrected by the teacher and returned to the students. Those who failed to master an objective as assessed by the first diagnostic measure were required to take a second parallel diagnostic measure on that same objective approximatley two days later. No further diagnosis was provided.

The Diagnostic-Remediation Level (T_3) received the same treatments as T_2 with the exception being students who failed to master an objective on the first diagnostic measure were given a set of remedial assignments to complete before taking the second diagnostic measure. This assignment was to be completed in class after normal classroom requirements were met or at home. No formal effort was made to insure that the student had completed the remedial assignment.

The activities of the three treatment levels can be diagrammed as follows:

T_1 = O ——————————————————————— S

T_2 = O ———— D_1 ——————————— D_2 ———— S

T_3 = O ———— D_1 ———— R_1 ———— D_2 ———— S

T = Treatment level

O = Set of instructional objectives

D = Diagnostic measure

R = Remediation

S = Summative

Data Collection

Because the sample was composed of intact groups, analysis of covariance procedures were used to statistically equate for group bias as determined by four pretreatment science achievement tests.

A modified Rotter Questionnaire was developed and used for determining level of locus of control. The questionnaire was modified in terms of vocabulary appropriate for middle school students. The levels of locus of control are defined as external (those individuals who scored at or above the mean) and internal (those individuals who scored below the mean).

Parallel items that corresponded to each objective were developed for use on the summative and retention measures. The validity of all achievement measure items was insured by systematically comparing them to the specific objectives. The reliability was determined by using the Kuder Richardson formula 21 (Hopkins & Stanley, 1973).

An attitude questionnaire with a Likert response format was developed to assess the students' opinions on three factors: use of instructional objectives, use of diagnostic measures for feedback, and use of remediation. All three treatment levels received the section on the use of objectives, T_2 and T_3 received the section dealing with the use of remediation for feedback, and the T_3 level answered questions that dealt with the use of remediation.

Research Design and Analysis

The following defines the research design using Campbell and Stanley notation:

$O_1 \quad O_2 \quad X_1 \quad O_3 \quad O_4 \quad O_5 \quad O_6$

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$O_1 \quad O_2 \quad X_2 \quad O_3 \quad O_4 \quad O_5 \quad O_6$

- -

$O_1 \quad O_2 \quad X_3 \quad O_3 \quad O_4 \quad O_5 \quad O_6$

In the above design the following symbols are used:

O_1 = Achievement on a set of pretreatment course examinations;

O_2 = Locus of control;

O_3 = Achievement on the first summative science achievement measure;

O_4 = Achievement on the second summative science achievement measure;

O_5 = A measure of attitude toward the use of objectives and diagnostic/prescriptive measures;

O_6 = Retention as measured by an equivalent form of the summative science achievement measure;

X_1 = Objectives Only Level

X_2 = Diagnostic Level; and

X_3 = Diagnostic Remediation Level

The data were analyzed using a 3 x 2 x 2 (treatment, LOC, race) factorial design with analysis of variance and covariance. The α level was .05.

RESULTS

The adjusted group means on all achievement measures are given in Table 1. On the first summative test (SA) there were no significant differences in the

Table 1

Summary of Adjusted Achievement Means for the Treatment, Locus of Control, and Racial Groups

Achievement Measure	Treatment Group			Locus of Control		Race	
	T_1	T_2	T_3	Internal	External	Black	White
SA	70.1	78.2	81.6	81.0	94.9	71.9	79.5
SB	77.3	82.5	81.2	84.7	76.9	77.5	80.9
RM	67.6	74.7	75.8	75.9	69.4	64.8	74.9

adjusted group means which could be attributed to treatment, locus of control, or race ($p > .05$) (see Table 2).

On summative test B there were no differences that could be attributed to treatment or race ($p > .05$); but, in regard to locus of control, internal subjects achieved significantly better than externals ($p < .01$) (see Tables 1 and 2).

On the retention measure there were significant differences related to treatment, locus of control, and race ($p < .05$). In relation to treatment differences post hoc analysis using Newman-Keuls procedures indicated that both the diagnosis (T_2) and diagnosis with remediation (T_3) groups achieved significantly higher than the objectives only group (T_1) ($p < .05$). On the locus of control variable, the internals showed significantly greater achievement than the externals ($p < .05$). In relation to race, white students scored significantly higher than black students ($p \leq .01$).

Within the α level, no significant interactions occurred between treatment and locus of control and race ($p > .05$) (see Table 2). There was one possible interaction in the retention data with a $p = .07$ that needs to be pointed out. The effects of treatment levels appeared to be inconsistant across races of the students. Figure 1 indicates that black students benefitted most from the diagnosis with remediation treatment while the white students retained more when they experienced diagnosis with no remediation.

The results of attitude assessments are given in Table 3. The mean attitude scores, of all groups, tended to be positive. Analysis showed that where groups responded to the same measure (i.e., attitudes toward diagnosis) no significant differences occurred ($p > .05$).

Table 2

Analysis of Covariance Results for
Achievement Measures

	Treatment		Locus of Control		Race		Interactions					
							T x L		T x R		L x R	
	F	P	F	P	F	P	F	P	F	P	F	P
SA	1.24	.30	2.56	.11	2.49	.12	2.02	.14	1.92	.15	.02	0.99
SB	.83	0.99	7.85	.01	.94	0.99	2.51	.09	1.28	.29	2.17	.14
Retention	3.60	.03	5.33	.02	7.95	.01	.17	.99	2.68	.08	.32	.99

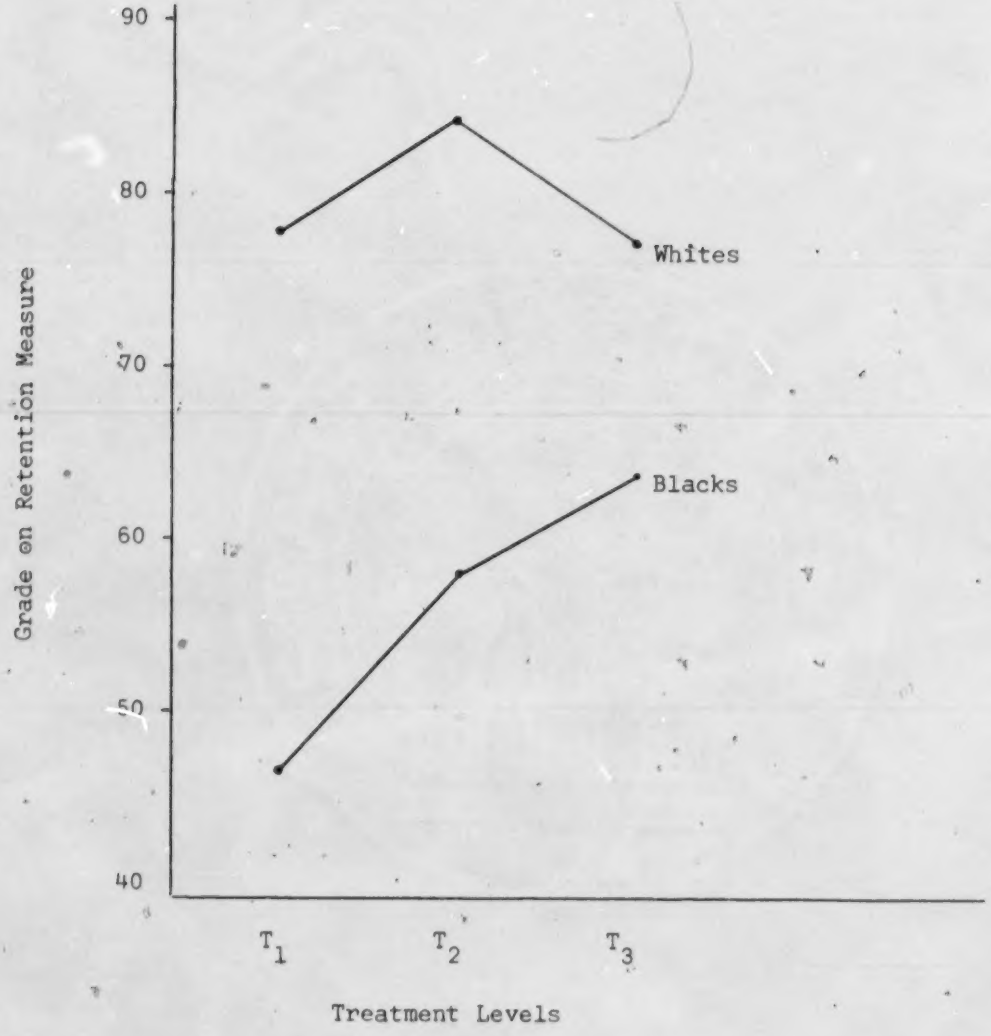

Figure 1. Treatment by race interaction on retention measure.

Table 3

Summary of Treatment Group Means for Attitudes Toward Use of Objectives, Diagnosis, and Remediation

Treatment Group	Objectives	Diagnosis	Remediation
T_1	3.7		
T_2	3.8	3.7	
T_3	3.6	3.6	3.7

CONCLUSIONS

A concern of educators is "what teaching approach is most beneficial for what type of students?" This study indicates that diagnostic-prescriptive (DP) teaching is an effective method for increasing retention in the middle school.

Although immediate achievement levels were not significantly increased by diagnostic remedial treatments, the students who experienced DP instruction showed a 10-12 percent greater retention of science information when compared to subjects who received none. It is possible that both the organization of subject matter and practice which are brought about through DP instruction maintain the student's retention over a long period of time (i.e., one month). Thus, retention differences were noted even when short term differneces in achievement were not significant.

Retention of subject matter is of primary importance because what the student remembers will affect his achievement and success in later studies. The immediate achievement levels, although important to determine grades, should not be of primary importance to educators. Because the students' knowledge is not always immediately evident it should be the role of the educator to guide the students' learning with long term goals in mind.

On the second summative measure and the retention measure, internal students scored higher than external students. These results are supported by similar findings of McGhee and Crandall (1968) who also found that "internals" attained higher levels of achievement than "externals". A probable explanation for these findings involves responsibility and motivation. Since the "internals" believe they have more control over their future grades than "externals", they may have more motivation and thus have taken the responsibility for their own success. It is also possible the DP instruction allows the internal student

to feel that he has more control over his grade than in conventional teaching methods.

On the retention measure white students attained higher levels of achievement than black students. The reason for this cannot be validly assessed within the limitations of this research. Many factors such as socioeconomic status, educational level of parents, and home environment are of importance. No personal data of these kind were collected in this study.

The attitude questionnaire indicated that although there were no differences in attitudes across groups, students had positive feelings toward the use of objectives, diagnosis, and remediation. These positive reactions are extremely important because if students' attitudes are negative in regard to certain classes or subjects, learning can be decreased.

It is not suggested that internal subjects receive any different type of instruction from externals, nor is it suggested that blacks be instructed differently from whites. Both internals and externals and blacks and whites benefitted from diagnosis as well as from diagnosis and remediation. It is important to remember, however, that achievement differences between blacks and whites are reduced by the use of remediation, and the use of diagnostic remedial strategies proves to be more effective than not using them. These methods should be implemented in middle school science classes as a means of improving retained achievement.

Suggestions for Implementation

When implementing a diagnostic-prescriptive unit there are two overall considerations: (1) preplanning and (2) adequate use of classroom time.

When planning an instructional unit, objectives must be developed along with corresponding diagnostic quizzes, summative tests, and remedial activities. The time needed to develop a unit can be considerable but the materials can be used again in subsequent years. In a sense, the more that materials are used the less the cost. To use class time efficiently, a schedule must be planned and followed. A specific amount of time must be designated for instruction, diagnostic quizzes, and remediation when needed.

The use of the diagnostic-prescriptive teaching method can thus lead to two benifits: (1) an increase in students' retained achievement, and, (2) the development of a system and materials that will lead to an increase in teacher efficiency.

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